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Station # 12

ENGINEERING DATA TRANSMITTAL

Page 1 of 1

1. EDT 160873

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Environmental Restoration Org. #81234	K. A. Bergstrom/ T. H. Mitchell	
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1	WHC-SD-EN-TI-117		0	Ground Penetrating Radar Investigation for Riverland ERA	4	1/2	1	

APR 1993

16. KEY

Impact Level (F)	Reason for Transmittal (G)	Disposition (H) & (I)
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1	1	Cog. Mgr. K.R. Fecht	K.R. Fecht	3/23/93	H6-06	G.C. HENCKEL			H6-04	3	
		QA				J. FASSETT			H6-06	3	
		Safety				CENTRAL FILES (2)			L8-04	3	
3		Env. R.J. VALCICH			H6-04	EDMC (2)			H6-08	3	
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K.A. Bergstrom 3-25-93 Signature of EDT Originator / Date	Authorized Representative for Receiving Organization / Date	K.R. Fecht 3/23/93 Cognizant/Project Engineer's Manager / Date	[ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments

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SUPPORTING DOCUMENT

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Signature

Organization/Charge Code 81234/PB62K

APPROVED FOR PUBLIC RELEASE 4/6/93 D. Soli

7. Abstract

Bergstrom, K. A., and T. H. Mitchell, 1993, *Ground-Penetrating Radar Investigation for Riverland ERA*, WHC-SD-EN-TI-117, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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CONTENTS

FIGURES:

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1.0 INTRODUCTION

The Riverland expedited response action (ERA) includes four sites within the 100-IU-1 Operable Unit. Ground penetrating radar (GPR) was conducted at two of the four sites, Riverland Railroad Maintenance Shop (RRMP) and the antiaircraft artillery (AAA) site number 70 (Figure 1).

The RRMP operated from 1943 through 1954 where radioactive decontamination was conducted on outgoing railcars from the Hanford Site in the locomotive house maintenance pits. In 1963, the RRMP facilities (Figure 2) were decontaminated, demolished, and the remains buried (Valcich 1992).

The AAA site was established in 1951, but remained active for only a few years (Valcich 1992). The site was demolished and all that remains are a few "outcrops" of foundations and three enigmatic mounds.

Five individual GPR investigations were conducted as part of the overall Riverland ERA package; two locations at the RRMP (Figure 3), and three at the AAA (Figure 4). Three extensions to the original surveys were necessary at the RRMP site. Each investigation consisted of a gridded survey designed specifically for each individual site.

GPR geophysical surveys at RRMP had two primary objectives; to locate the buried maintenance pits and to determine whether a 12,000-gal, underground diesel fuel storage tank was removed during decommissioning. During the initial phases of the investigation, two pipes of unknown origin were detected. Subsequent survey extensions were required to determine their extent.

At the AAA site, GPR was conducted over the three "mounds" to determine what, if anything, was buried beneath them.

This report summarizes the interpretation of the GPR investigations for all five sites. The GPR data are contained in a data package (Bergstrom and Mitchell 1992).

2.0 GEOLOGIC SETTING

The RRMP is situated on the south limb of the Waluke syncline, which lies between two, topographically high, anticlinal ridges: Saddle Mountain and the Umtanum Ridge. The suprabasalt sediments that underlie the site include the Ringold Formation, Hanford formation, and Holocene surficial deposits (Figure 5).

Regionally, the Ringold Formation varies from gravel dominated intervals to mud dominated intervals. The upper Ringold, which consists primarily of silts and sands, has most likely been removed during the Missoula floods. In its place is the Hanford formation, which in this area is dominated by high-energy fluvial flood gravel deposits.

The Holocene sediments are primarily Columbia River and eolian deposits. The river deposits consist of gravel and coarse-grained sands deposited in channels and overbank silts and fine sands. Eolian deposits consist of a thin veneer of fine silty sands overlying the coarse Columbia River gravels and/or Hanford formation gravels (Lindsey 1992). The depth investigated with the GPR was limited to the Holocene and possibly the upper Hanford formation.

The AAA site is located on the south limb of the Umtanum Ridge structure. The suprabasalt sediments are thin in this area with the depth to the top of the basalt being <25 feet. The Ringold Formation is not present and the Hanford formation, if present, is limited to slack-water Touchet bed silts and sands, and scattered gravels from iceberg remnants related to the Missoula floods. Eolian silty loam is believed to be the predominant material overlying the basalt. However a petrocalcic horizon consisting primarily of basalt colluvium immediately overlies the basalt and may be up to 10 to 15 feet thick.

3.0 GROUND PENETRATING RADAR METHODOLOGY

The GPR system used for this work used a 300-MHz antenna to transmit the electromagnetic energy into the ground. The transmitted energy is reflected back to a receiving antenna where variations in the return signal are recorded. Common reflectors include natural geologic conditions such as bedding, cementation, moisture, and clay, or man-made objects such as pipes, barrels, foundations, and buried wires.

Depth of penetration at Hanford is generally between 1 to 15 feet, depending on the subsurface conditions, which can vary from site to site. The method is limited in depth by transmit power, receiver sensitivity, and attenuation of the transmitted energy. Depth of investigation is also influenced by highly conductive material, such as metal drums, which reflect all the energy back to the receiver. Therefore, the method cannot "see" below such objects.

Display and interpretation of the data are similar to seismic reflection data. In some areas, interpretations can be straightforward, but often unknown parameters within a highly variable subsurface yields complex data.

Data for these surveys were collected with a Geophysical Survey Systems Inc. (GSSI) Subsurface Interface Radar (SIR) System 8, model 4800. The data were digitally stored on a GSSI DT6000A tape drive. A recording window of 100 nsec, two-way travel time, was used.

4.0 GRIDS

All five GPR investigations and subsequent extensions were gridded surveys. Distances were measured and posted in feet. Green stakes mark the corners of each grid. The southeast corner of each grid is designated E100/N100 and serves as the "origin" for the survey locations. The number

refers to a distance in feet. For example, grid point E135/N120 lies 35 feet "east" and 20 feet "north" of grid point E100/N100. The letters "N" or "E" refers to a direction that trends generally north or east, respectively. Two sets of orthogonal profiles were collected at each site with a 5-foot spacing between profiles.

5.0 RESULTS

5.1 RRMP SITE

The RRMP survey was conducted in three phases. The first phase was directed at detecting the wash pits within the railroad maintenance building. Phase II was designed to investigate the buried diesel tank. Phase III included extensions to Phase I and II grids to determine the extent of two pipes of unknown origin.

5.1.1 RRMP "Pits" Phase I

The objective of Phase I was to locate the buried maintenance pits in the locomotive house (Figure 3). Aerial photographs (before and after demolition) were used for approximating the location of the locomotive house. A 60- by 120-foot grid (Figure 3) was established over the assumed location. Several GPR profiles were extended beyond the grid to enhance the interpretation on a "real-time" basis.

A summary of the interpretation of the GPR data is shown in Figure 6. The data revealed several strong near-surface reflectors that are similar in character to concrete slabs. In the northwest corner of the grid, a shallow "slab-like" reflector has a consistent signature. The slab-like reflectors throughout other portions of the grid display more discontinuity. Two parallel disturbed areas, with similar reflective characteristics, pass through the middle of the grid. They correlate with a pair of railroad tracks that went through the locomotive house (Figure 2). The rails may have been removed, leaving the foundation for the tracks. In the western half of the grid, there is an "H-shaped" disturbed zone, 2 to 5 feet below the surface. Portions of the "H" zone contain some slab-like reflectors.

The interpretation of the GPR data was compared to the construction plans for the facility; there were no "as-built" drawings available. The comparison yielded definite similarities; enough to conclude that the survey was conducted over the location of the original RRMP building (Figure 3).

It is believed that the H-shaped anomalous zone includes portions of the original pits as shown in Figure 7. The pits appear to be partially filled with debris. Figures 8 and 9 show GPR data across the pits.

5.1.2 RRMP Diesel Tank Phase II

The objective of Phase II was to determine if a 12,000-gal diesel tank had been removed, and if not, where the tank was located. From facility plans

and aerial photographs, it was determined that the tank, if present, should be located approximately 50 feet to the southwest of the locomotive house (Figure 3). An EM-31 electromagnetic induction (EMI) instrument was used for reconnaissance investigation. The area was full of metallic debris making it difficult to differentiate between individual anomalies. However, an area with a greater density of anomalies was found in the proximity of the tank location, based on available facility maps and photographs. The EMI surveys were conducted and interpreted in "real time" as a tool to refine the size and location of the grid that would be used for GPR. The EMI data were not recorded.

Based on the reconnaissance EMI survey and the facility plans, a 50- by 100-foot grid (Figure 3) was selected for the investigation. The data revealed a complex mixture of disturbed zones, buried debris, linears, geologic features, and numerous isolated anomalies.

A disturbed zone, between N70 to N90 and E10 to E40, is the only anomalous area identified, within the grid, that is large enough for a 12,000-gallon tank (Figure 10). There is no large "tank-like" anomaly within this zone, rather the zone is filled with buried, scattered, conductive debris. According to facility drawings, the boiler house was at this location indicating that this location is unlikely as a possible tank location.

A smaller disturbed zone, located 10 to 15 feet east of the large zone, displays a relatively strong, buried anomaly at E60/N74 (Figure 10). This anomaly does not appear to be large enough for a 12,000-gallon tank, though.

Centered around E45/N100 is a shallow slab-like feature that appears to be a portion of one of the original buildings, specifically the coal storage building.

Three linears were identified that potentially represent utilities/ pipes. Two are east-west trending features, at N95 and N100. The third is a north-south linear at E68. These linears probably correlate with the east-west and north-south trending pipes in the drawing even though their locations do not perfectly match. A fourth, southwest-northeast trending linear, located in the northeast corner of the grid is more puzzling since there are no pipes or utilities in the plans that have a similar orientation (Figure 10). However, this linear lies in the most direct path from the locomotive house to a potential, fuel tank location.

A small anomaly at E85/N60 appears to correlate with a manhole related to a sewer line shown on the facility drawings (Figure 3). The pipes into the manhole were not detected, suggesting that they may be tile pipes.

Based on correlations between the GPR data, aerial photographs, and facility drawings, it appears that the grid was adequately located. However, there are no anomalies that appear to be from a 12,000-gallon tank.

It is possible that the tank is located beyond the survey boundaries. But it seems unlikely since the GPR data, facility drawings, and photographs indicate that the locations of buildings are relatively accurate.

Even though the facility drawing for the diesel tank and its feeder lines do not correlate exactly with the GPR data, the general "pattern" of linears, disturbed areas, and possible concrete slabs resemble those of the aerial photographs and facility drawings.

5.1.3 Phase III Extensions

During the interpretation of the diesel tank data, a pipe of unknown origin or purpose was detected in the northwest corner of the survey along profile N95 (Figure 10). The pipe was not shown on any of the supplied drawings. The GPR Phase II grid was extended an additional 80 feet to the west (Phase III west extension) to determine the extent of the pipe and whether there were any unknown structures that the pipe serviced.

The data revealed no evidence for additional buildings. However, the pipe was traced to a 4- by 4-foot wooden box/crib (Figure 11) that has the appearance of a drainage/drywell.

The objective of the Phase III east extension was to trace a pipe that was uncovered during an exploratory excavation that was conducted immediately south of the locomotive house (Figure 3). The pipe was suspected as a possible drainpipe from the wash pits. It was traced by excavation approximately 40 feet to the south where it came to a "T". GPR was then used to determine the extent of the pipe. The pipe was traced approximately 300 feet to the east where it emptied into an open ditch along the railroad tracks (Figure 12). An interpretation of the GPR signature over the pipe leads to the conclusion that the pipe is probably nonmetallic (e.g., vitrified clay).

5.2 AAA SITES

The objective of the AAA investigations was to determine if debris was buried beneath three enigmatic mounds. There was concern that the mounds might include buried hazardous material. No site plans, aerial photographs, or facility plans were available for the AAA site.

A grid was constructed over each mound, the grid size being dictated by the size of the mound to be investigated. Adjacent, heavy vegetation limited the size of the investigation is some cases.

5.2.1 AAA #1

Gun site AAA #1 appears to be the remains of a foundation for a building. A strong shallow reflector (Figure 13), 1 to 2 feet below the surface, dominates the data. It has the characteristics of a buried concrete slab. Exposures of concrete appear to be the remains from the foundation walls of a structure. These exposures and the shallow reflector are assumed to be directly related. Minor amounts of debris were detected outside of the apparent slab (Figure 14), but all of these anomalies appear to be relatively isolated and insignificant.

The relationship of an exposed vertical pipe (Valcich 1992) located in the southwest corner of the grid to a possible subsurface feature was not apparent in the data. An extension of the grid to the west and south would be required to more thoroughly investigate the feature. This area is heavily vegetated with sage brush. Additional data could be acquired after removal of sagebrush.

5.2.2 AAA #2

The primary features identified in AAA #2 were an anomalous zone between N108 and N155 and a shallow, east-west trending linear between N100 and N110 (Figure 15). The zone includes a shallow, pervasive, near-surface reflector (<2 feet deep), which overlies a second reflective horizon 1 to 2 feet below (Figure 16). The shallower, reflective horizon appears to be another slab-like anomaly. The lower reflector is more puzzling. It is less pervasive, which could be a function of depth or partial masking by the upper reflector. It is not detected outside of the extent of the upper horizon. Both seem to be the remnants of a building or structure.

There are several small scattered anomalies within the mound. They appear to be debris left from the demolition of the original structures.

The linear anomaly has the characteristics of a utility line or buried pipe. A possible scenario is that the linear represents a utility line that led to a building that was located in the anomalous area described above.

5.2.3 AAA #3

The primary features in AAA #3 are two anomalous zones and a north-south trending linear between E120 and E130 (Figure 17). The northern most anomalous zone has the characteristics of a shallow (1 to 2 feet below the surface) concrete slab. The southern anomalous zone is characterized as more "disturbed" relative to the surrounding area. Some debris appears to be buried within the mound. The linear anomaly is approximately 2 feet below the surface. It could be a section of pipe, cable, or the remnants of a foundation wall.

6.0 SUMMARY

The comparison of the interpretation of the GPR data and the facility drawings for the RRMP site yielded enough similarities to conclude that portions of the original "pits" were identified as shown in Figure 7. The pits appear to be partly filled with debris.

Based on a comparison of the GPR interpretation, facility drawings, and aerial photographs, it was concluded that the survey had been conducted over the apparent location of the diesel tank. No anomalies of the size and character of a 12,000-gallon diesel tank were detected, indicating that it may have been removed.

Both of the pipes that were traced while conducting the extensions to the original surveys appear to be drainage pipes from the local facilities.

All three mounds at the AAA site appear to represent areas that once had buildings or structures related to the operations of the antiaircraft installation. Scattered, isolated anomalies in each of the sites indicate likely remnants of buildings that once occupied each site. Aerial photographs or drawings for the AAA sites would significantly help in confirming and enhance the interpretations.

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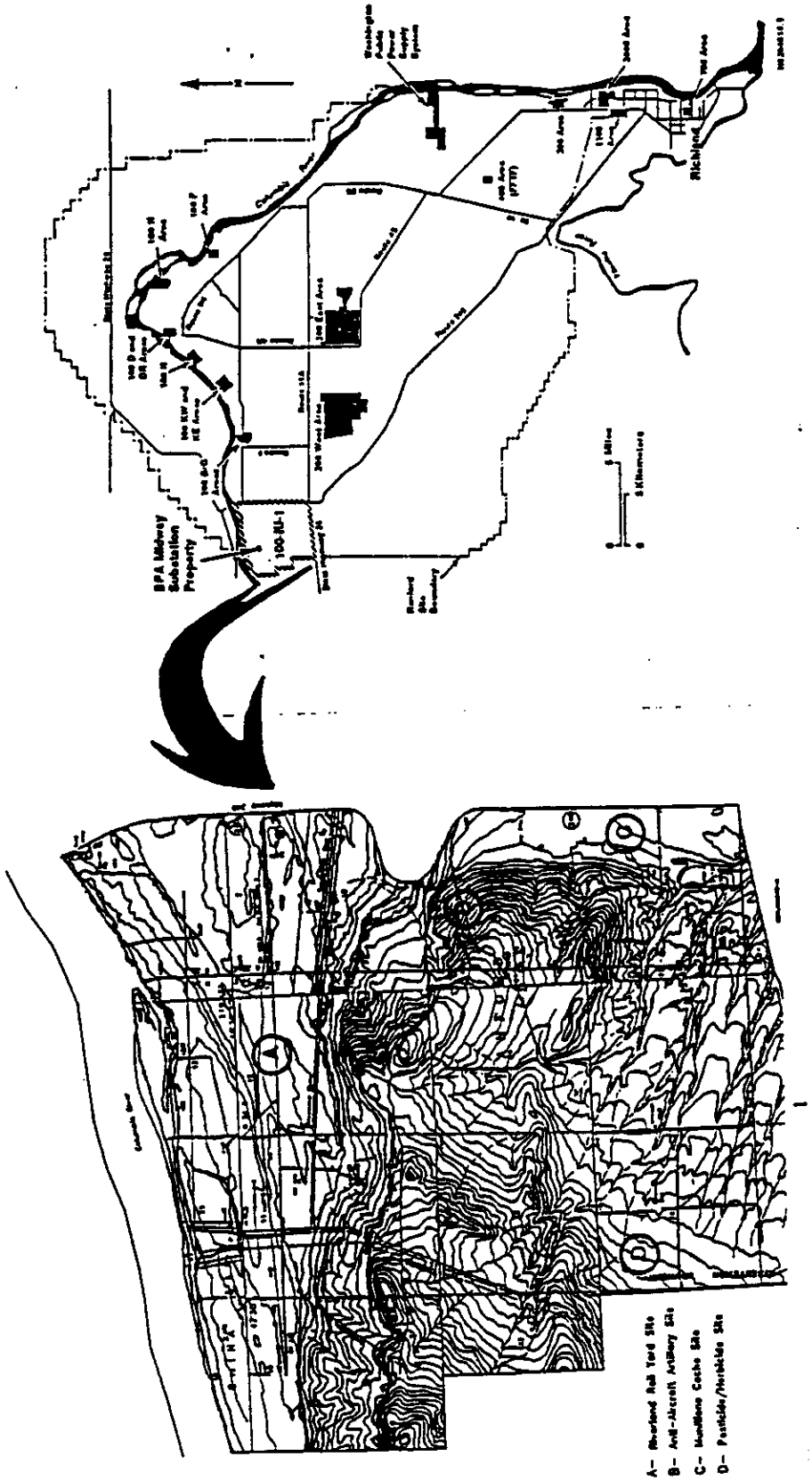
Valcich, P. J., 1992, *Riverland Expedited Response Action Project Plan*, WHC-SD-EN-AP-102, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Figure 1. Location Map for Riverland ERA.



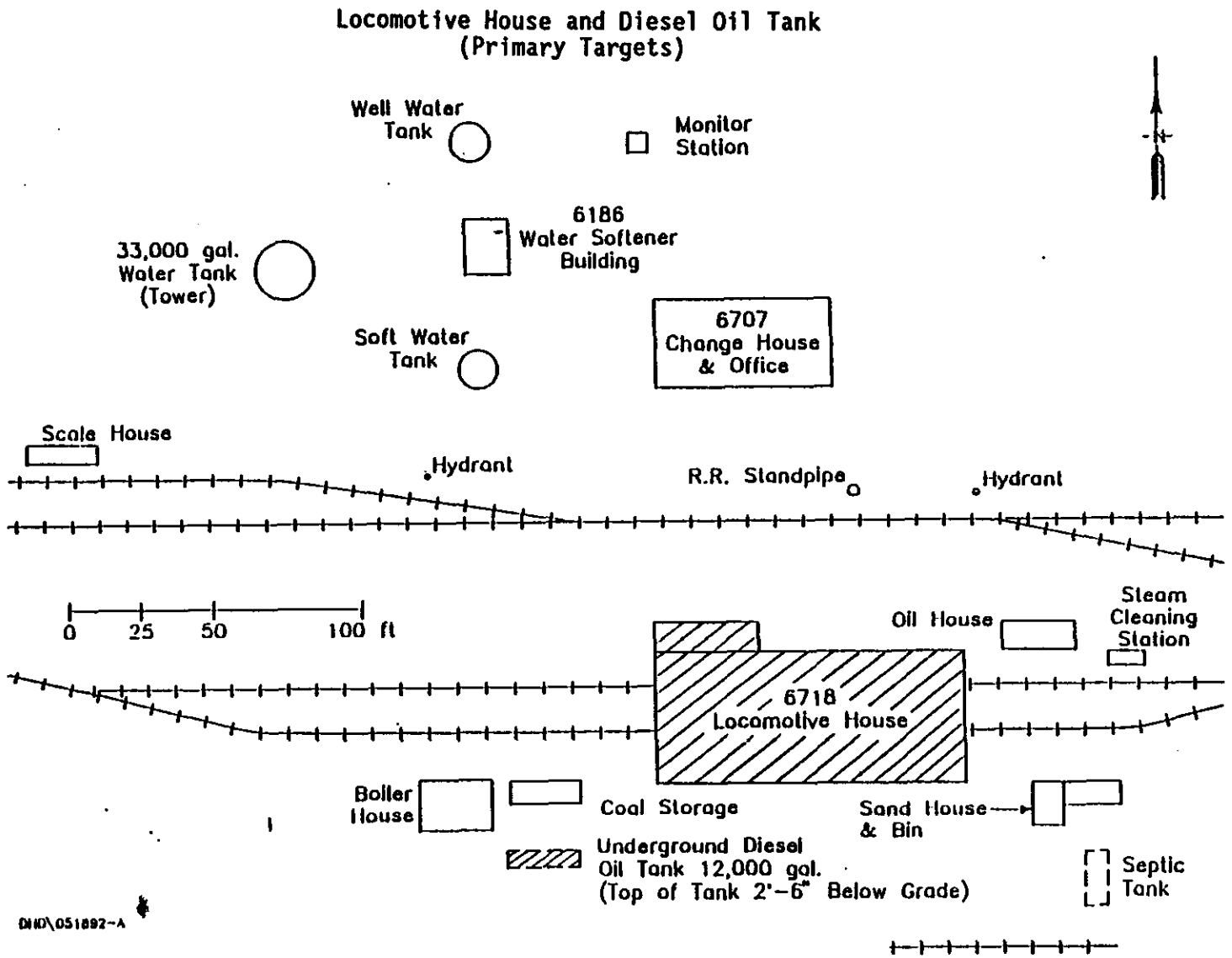
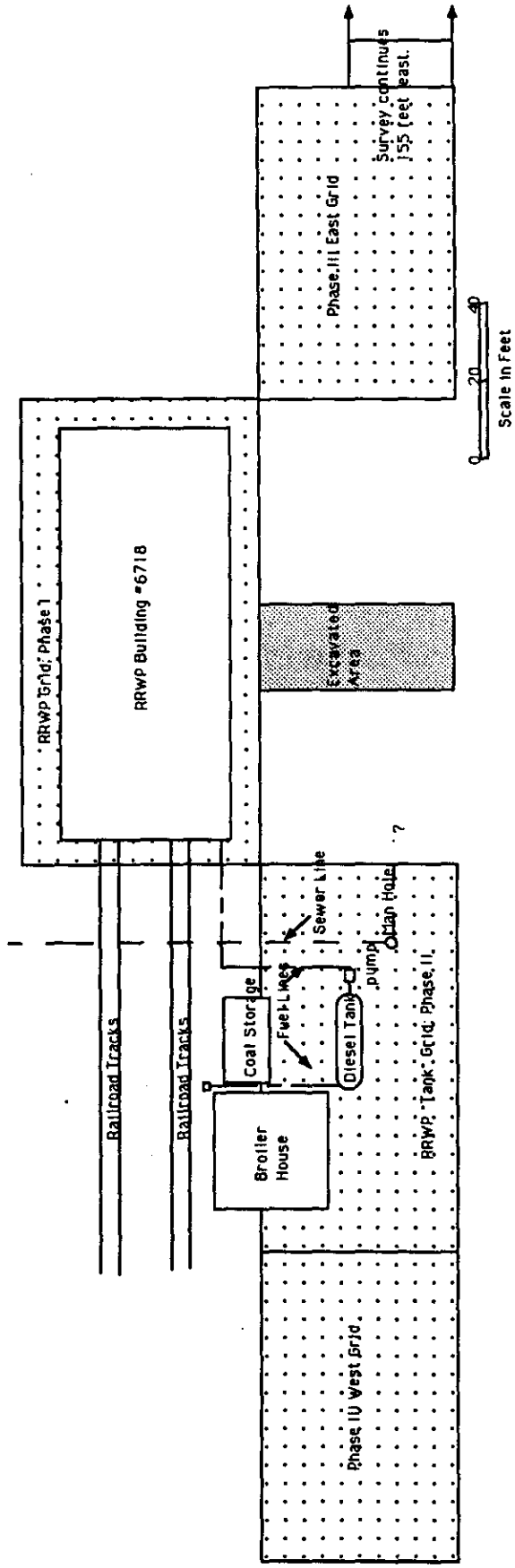


Figure 2. Riverland ERA Facility Map.

Figure 3. Diesel Fuel Tank and Surrounding Facilities.



(From a compilation of drawings and aerial photographs.)

Figure 4. Riverland ERA Antiaircraft Site Grids.

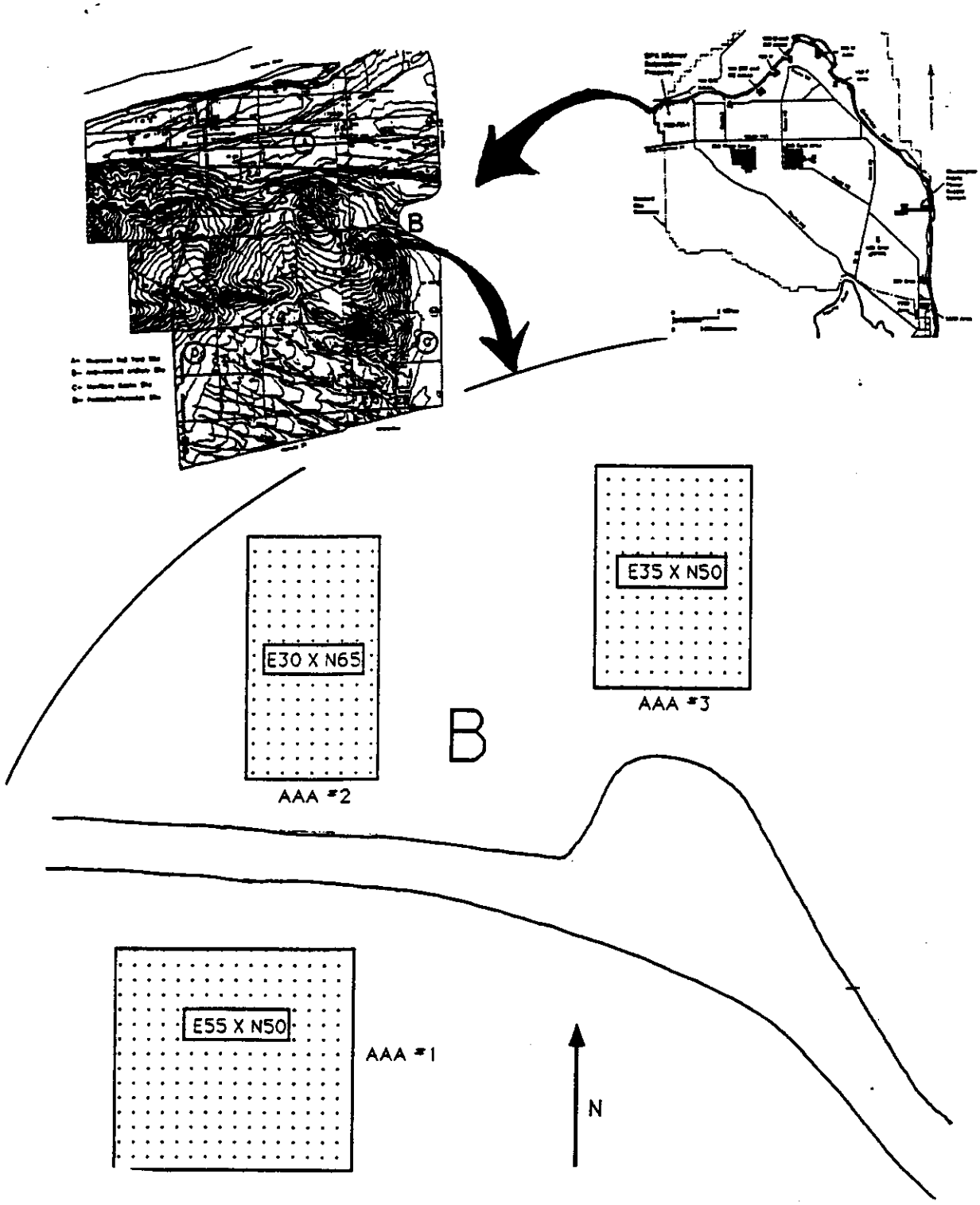


Figure 5. Generalized Upper Geostratigraphic Column for the 100-H Area.

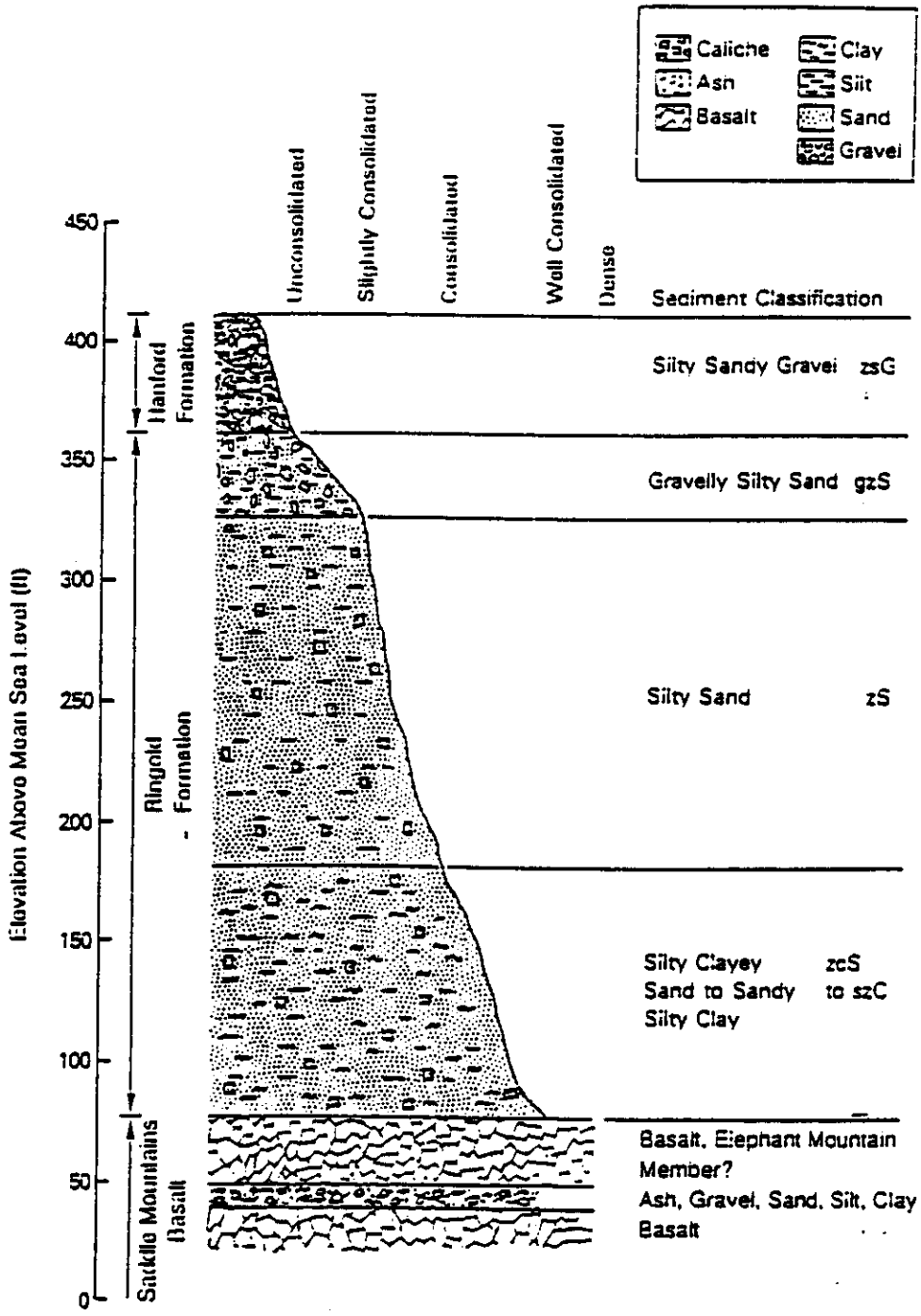


Figure 6. Ground Penetrating Radar Summary-Interpretation of the Riverland ERA Railroad Depot.

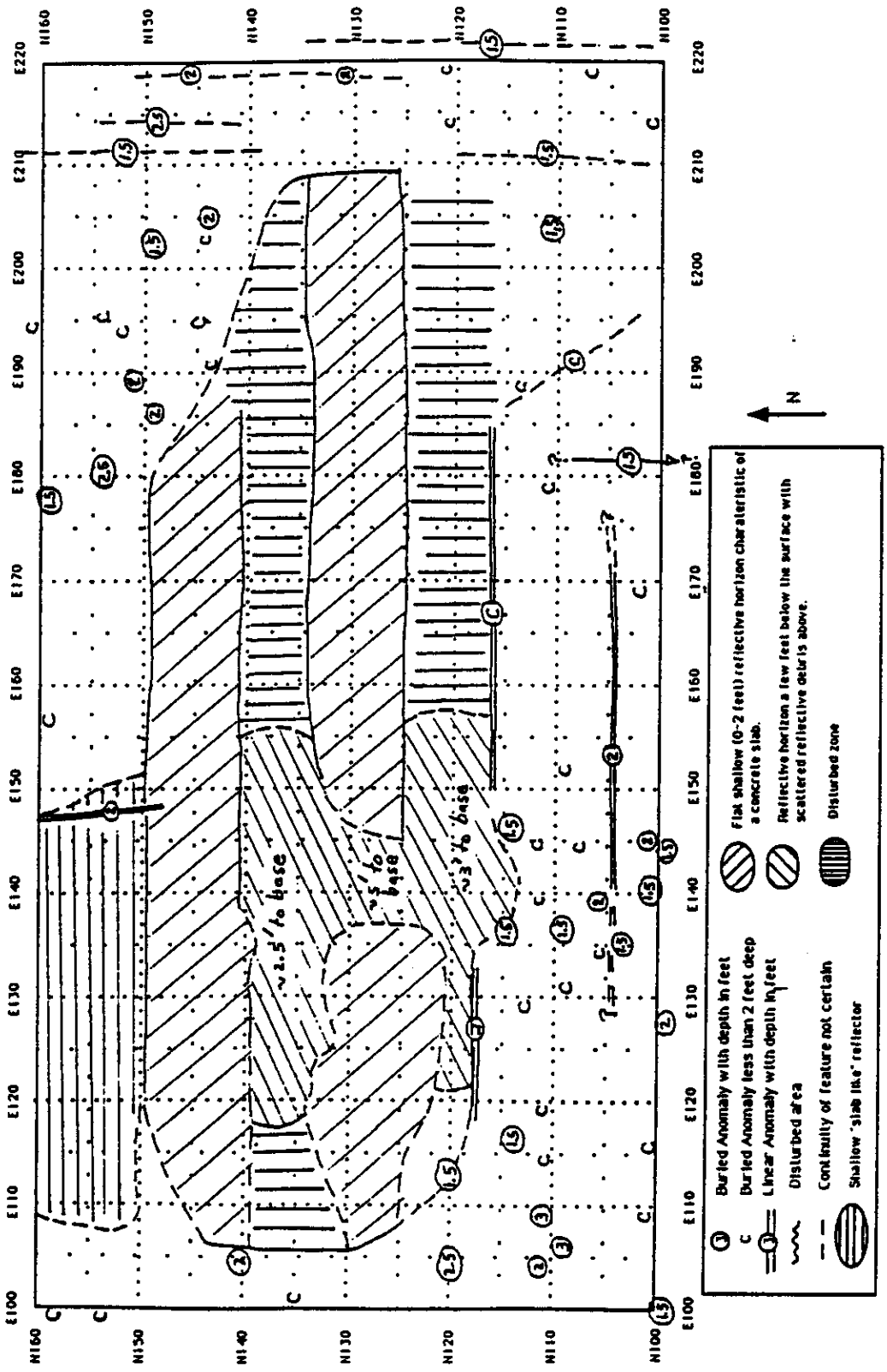


Figure 7. Interpretation Summary of RRWP with Facility Overlay.

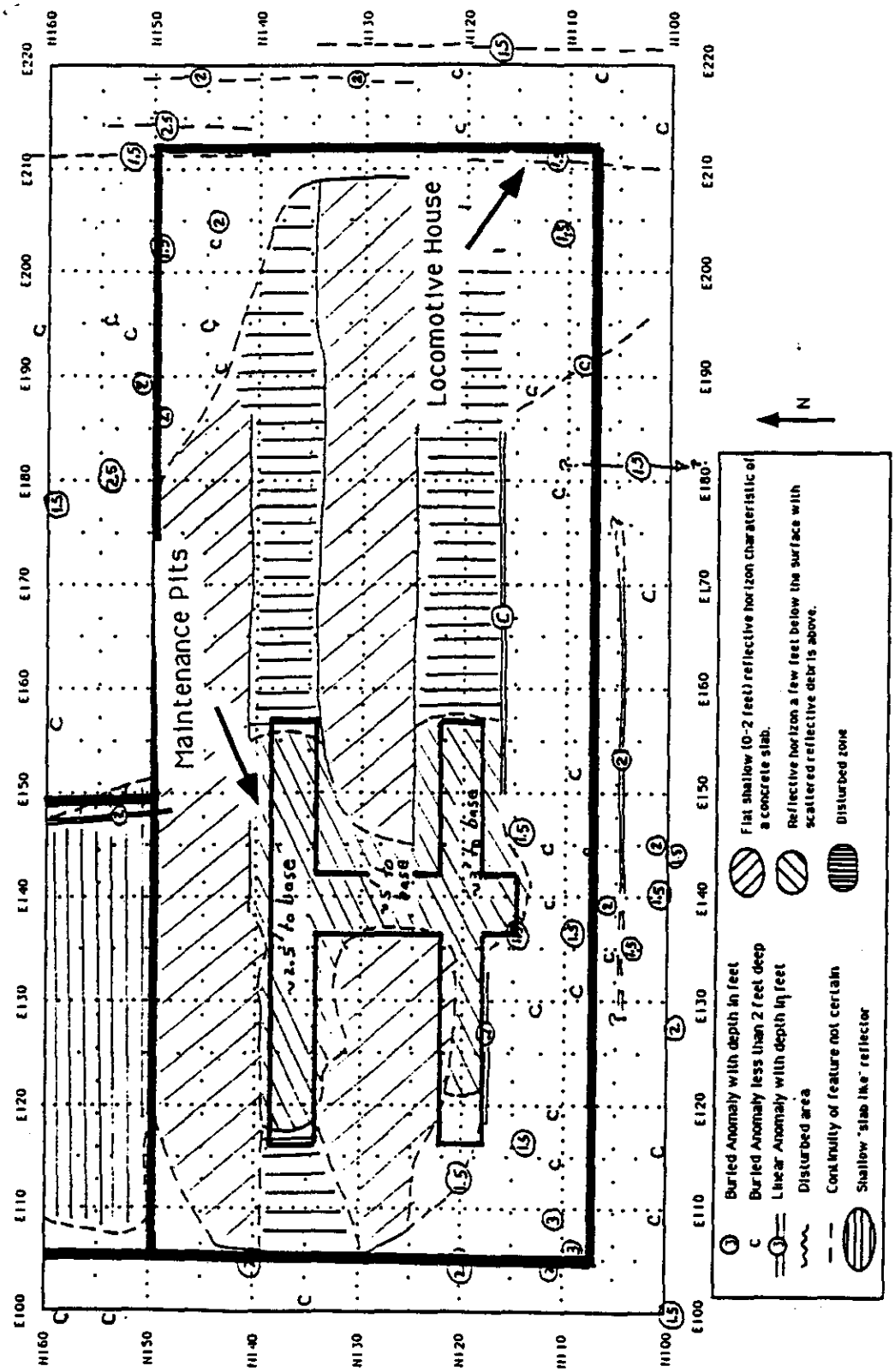
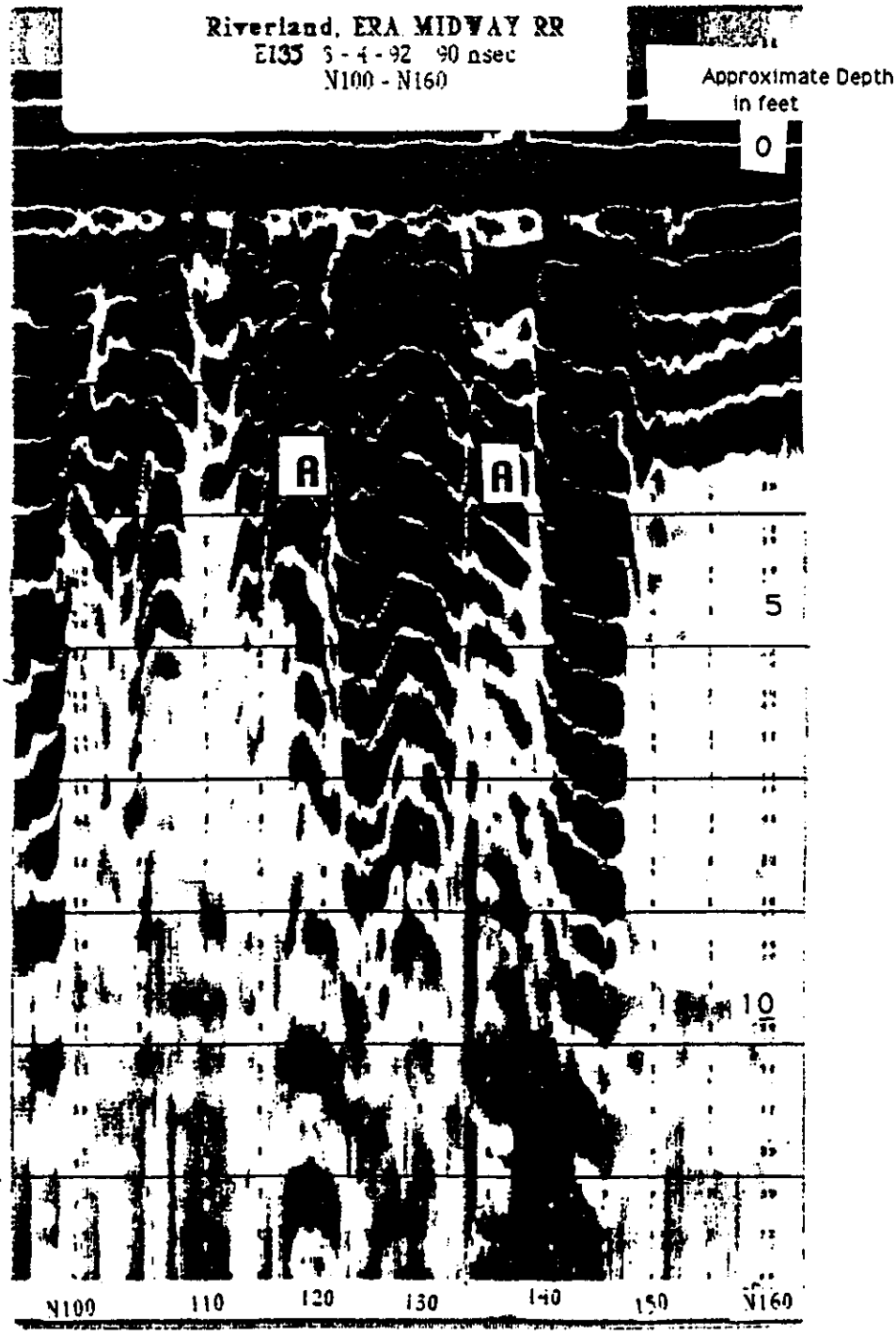


Figure 8. Interpreted "Pits" Surrounded by Slab-Like Anomalous Features.



A = Interpreted "Pits"

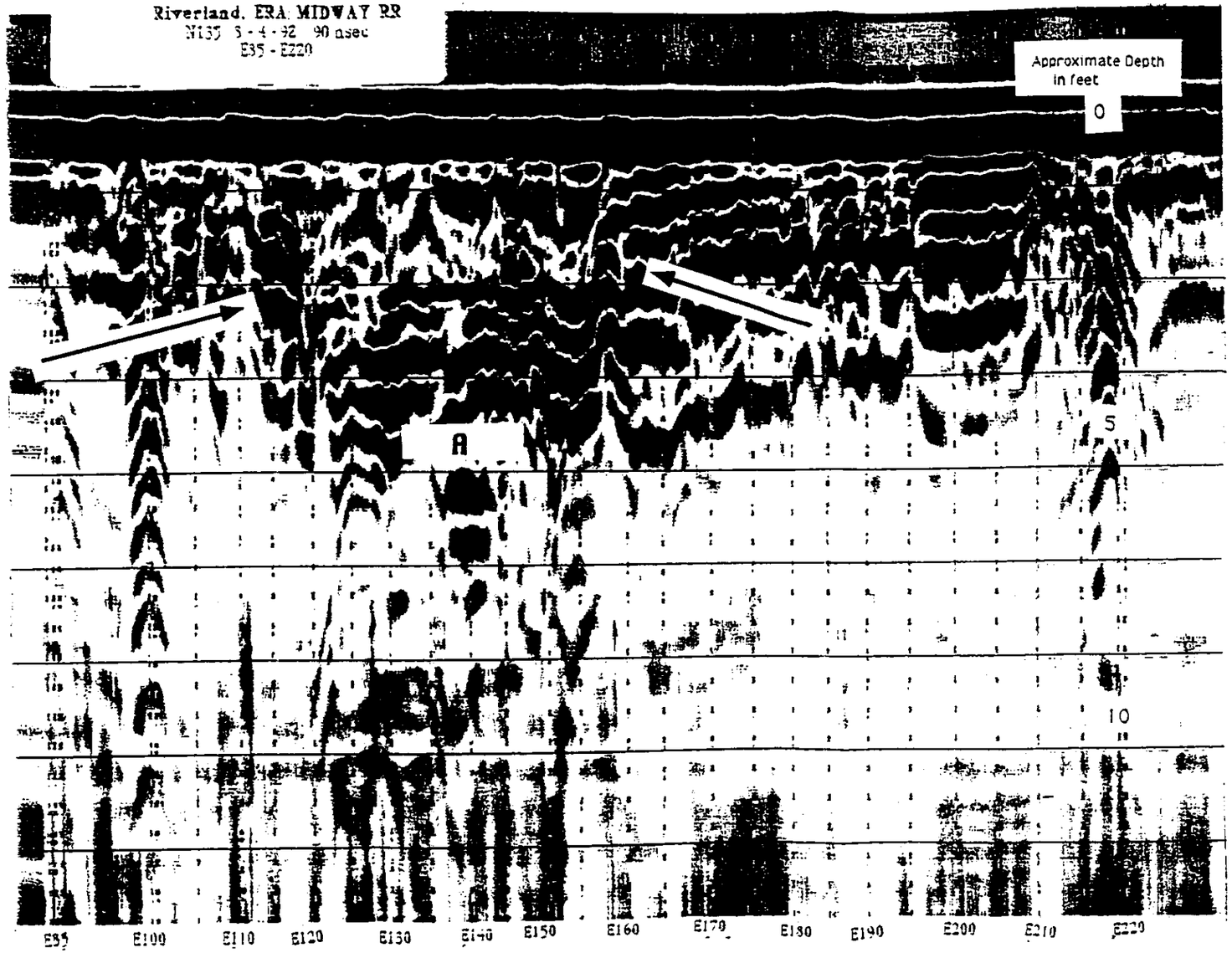


Figure 9. Interpreted Long Axis of "Pit".

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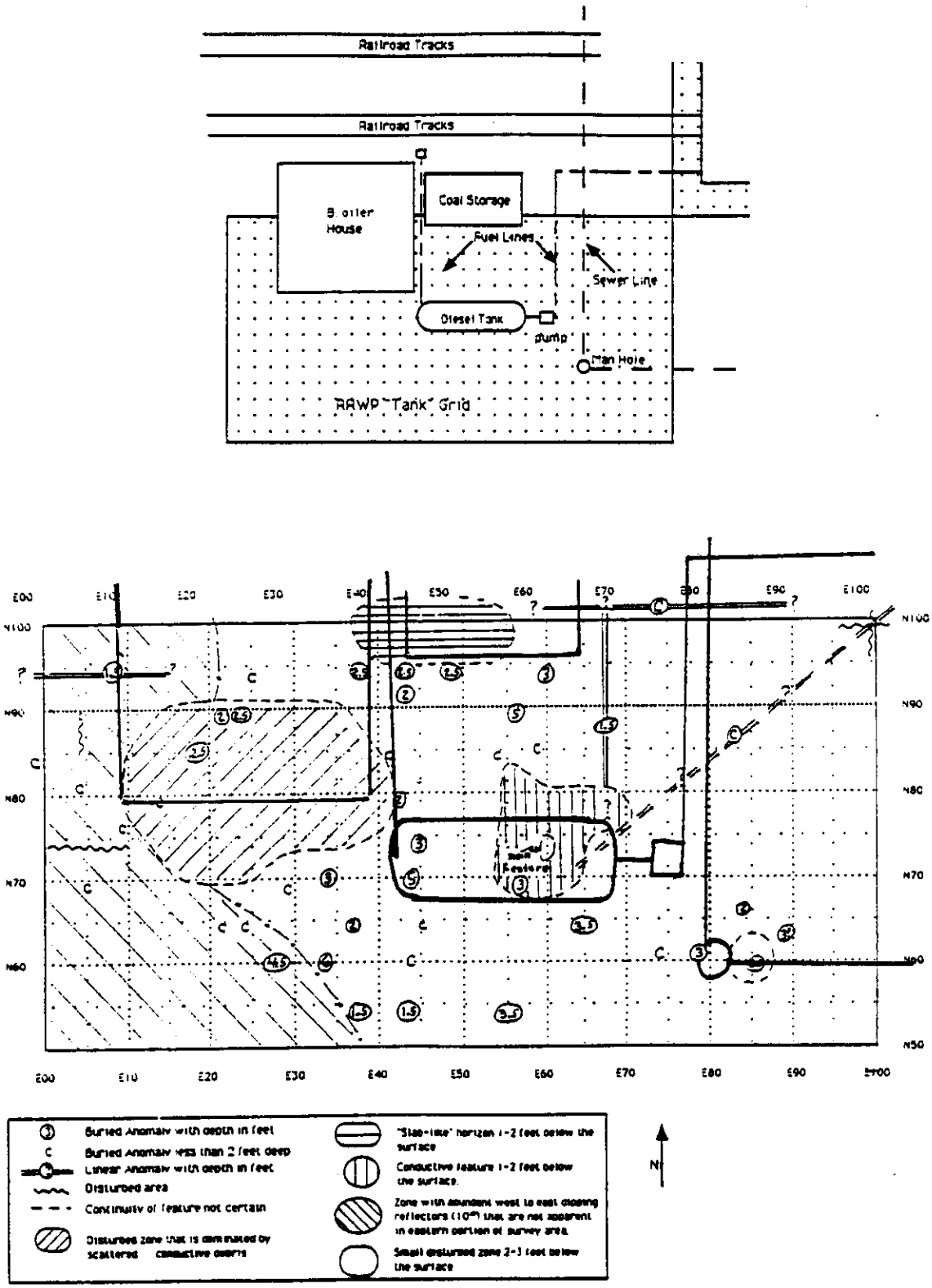
Figure 10. Summary Interpretation of Diesel Tank Investigation Overlaid by Apparent Facility Locations.



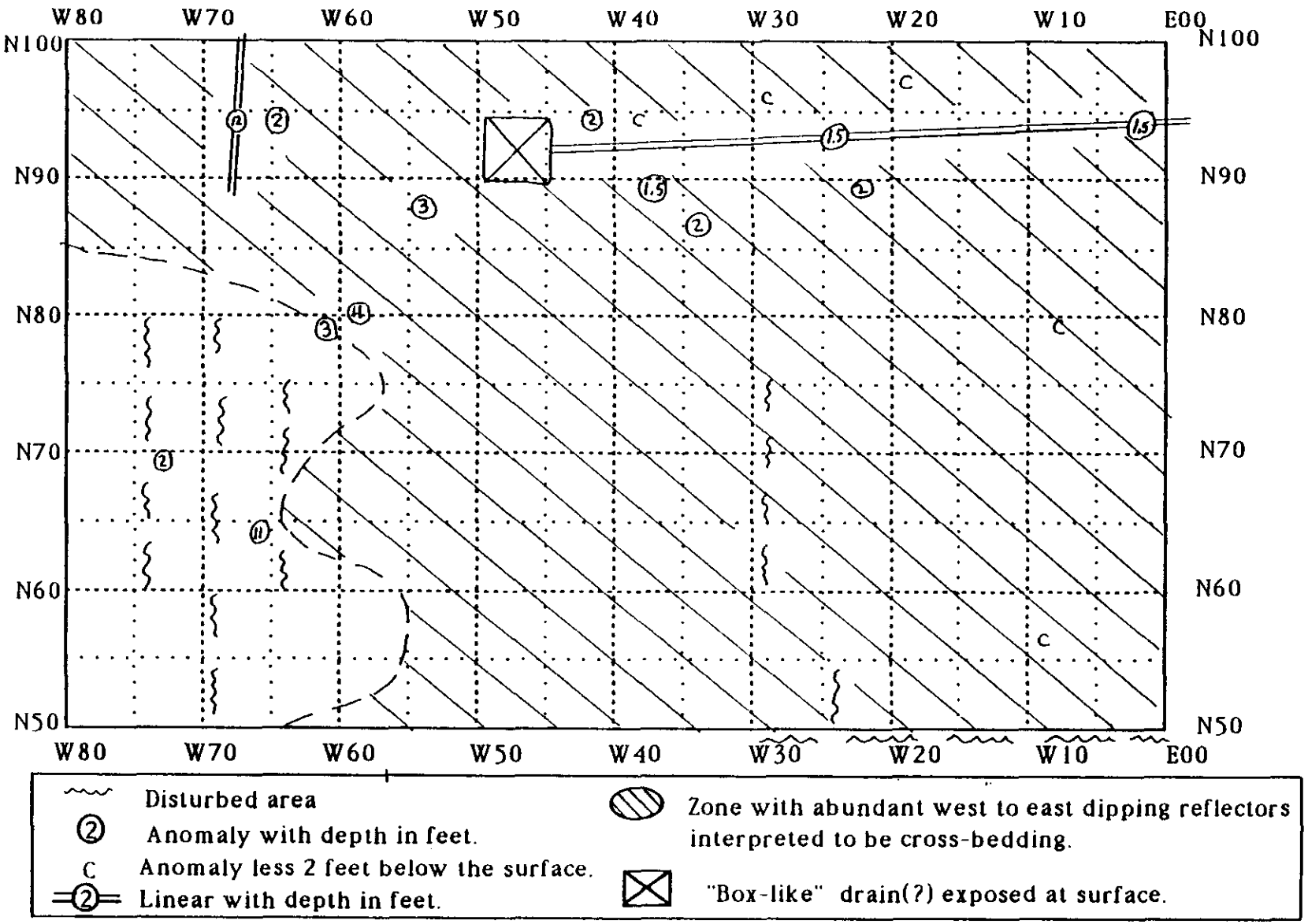


Figure 11. Summary Interpretation, Phase III West Extension.

Figure 12. Tracking of Pipe from Railroad Wash Pit.

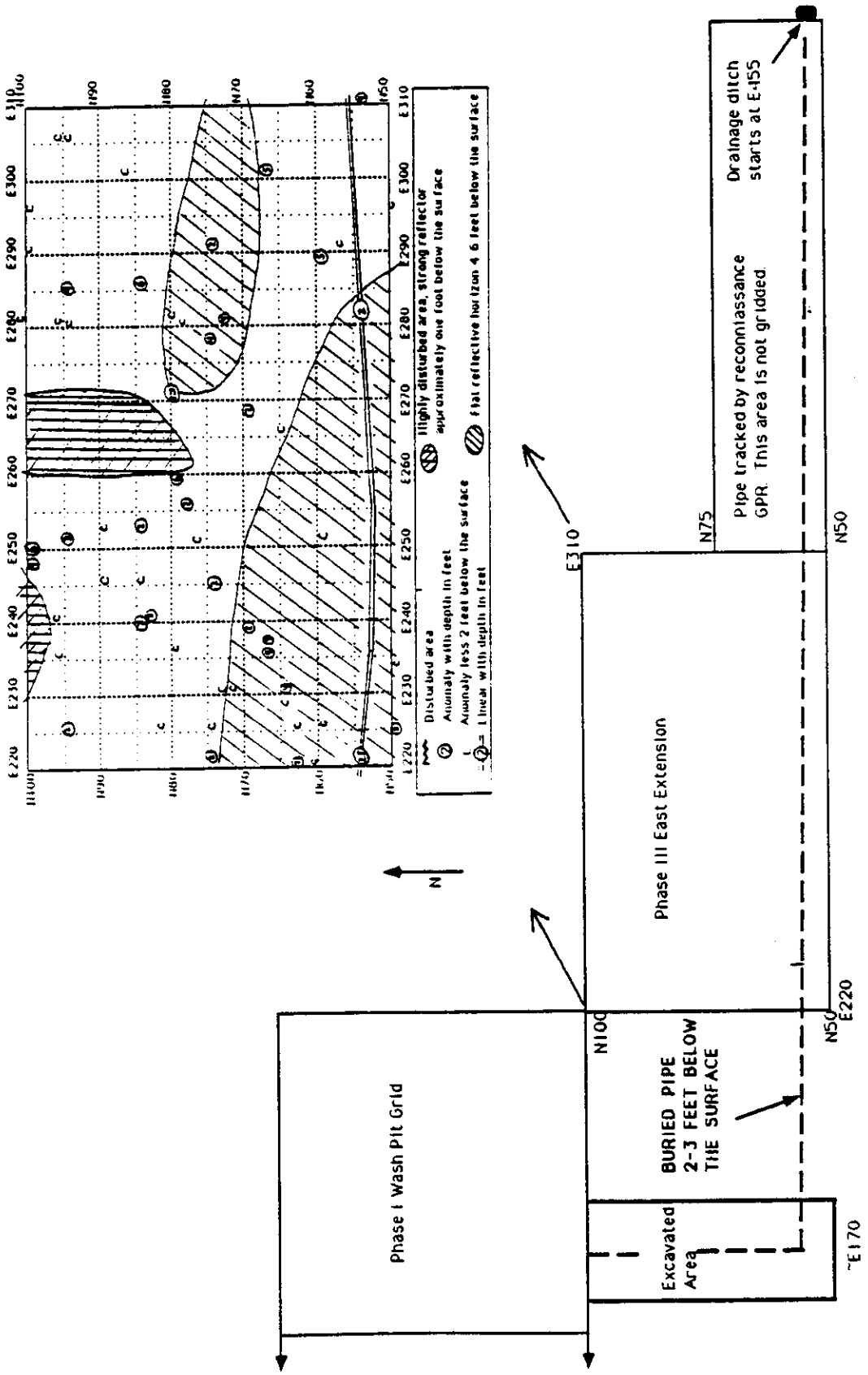


Figure 13. GPR Interpretation Summary of Riverland ERA AAA Site #1.

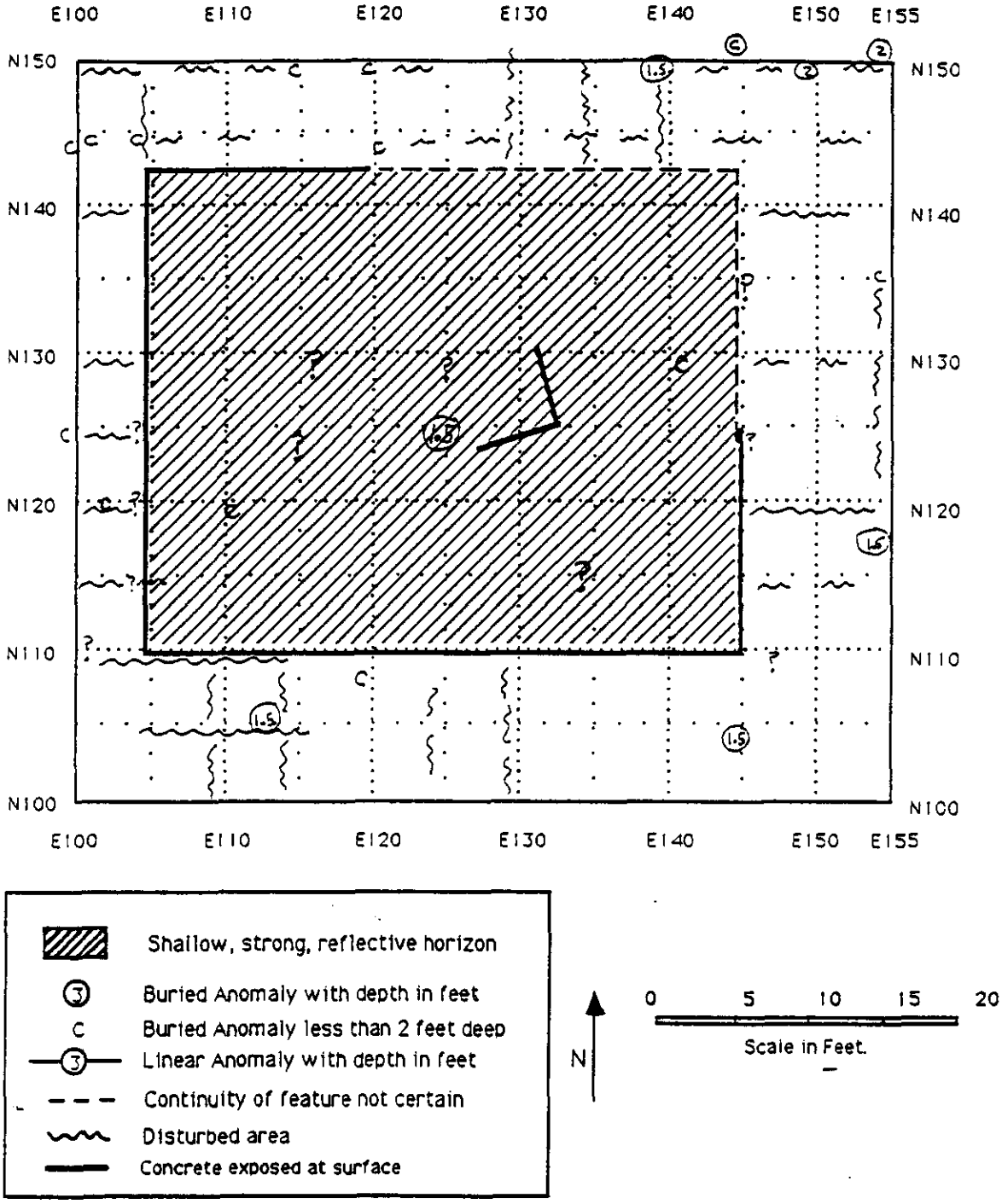
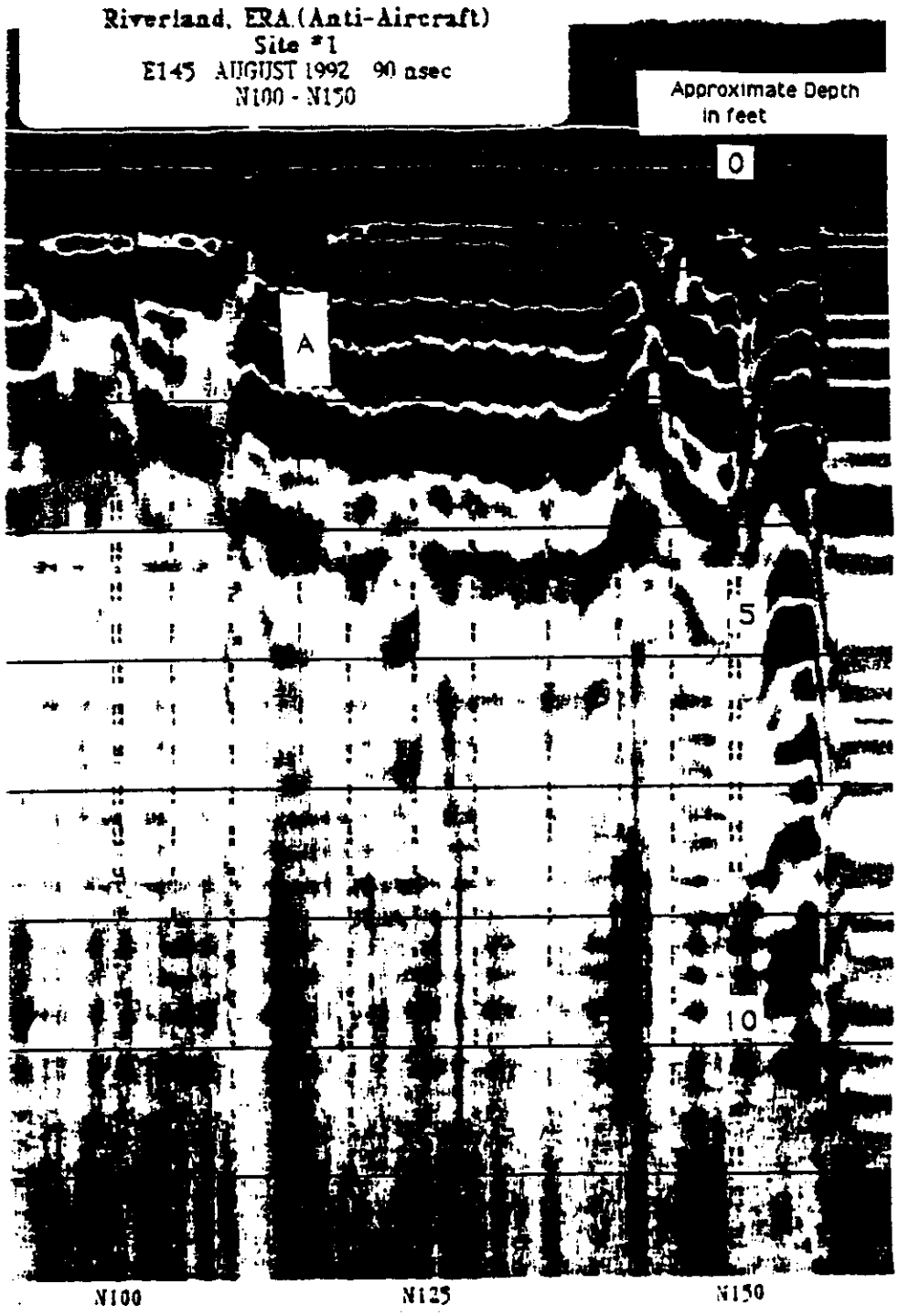


Figure 14. GPR Profile, AAA Site #1.



A = Shallow "Slab-like" Reflector

Figure 15. GPR Interpretation Summary of Riverland ERA AAA Site #2.

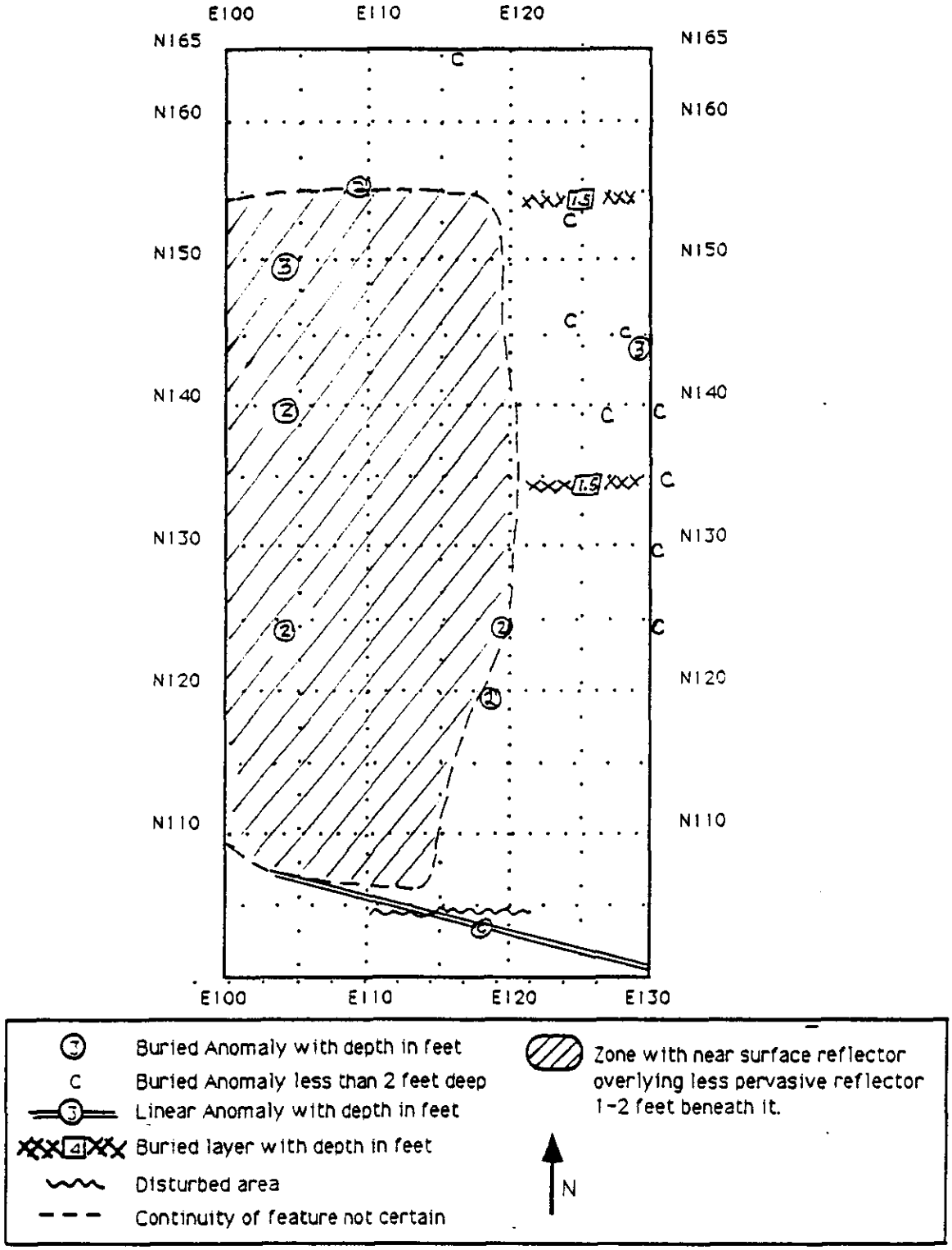
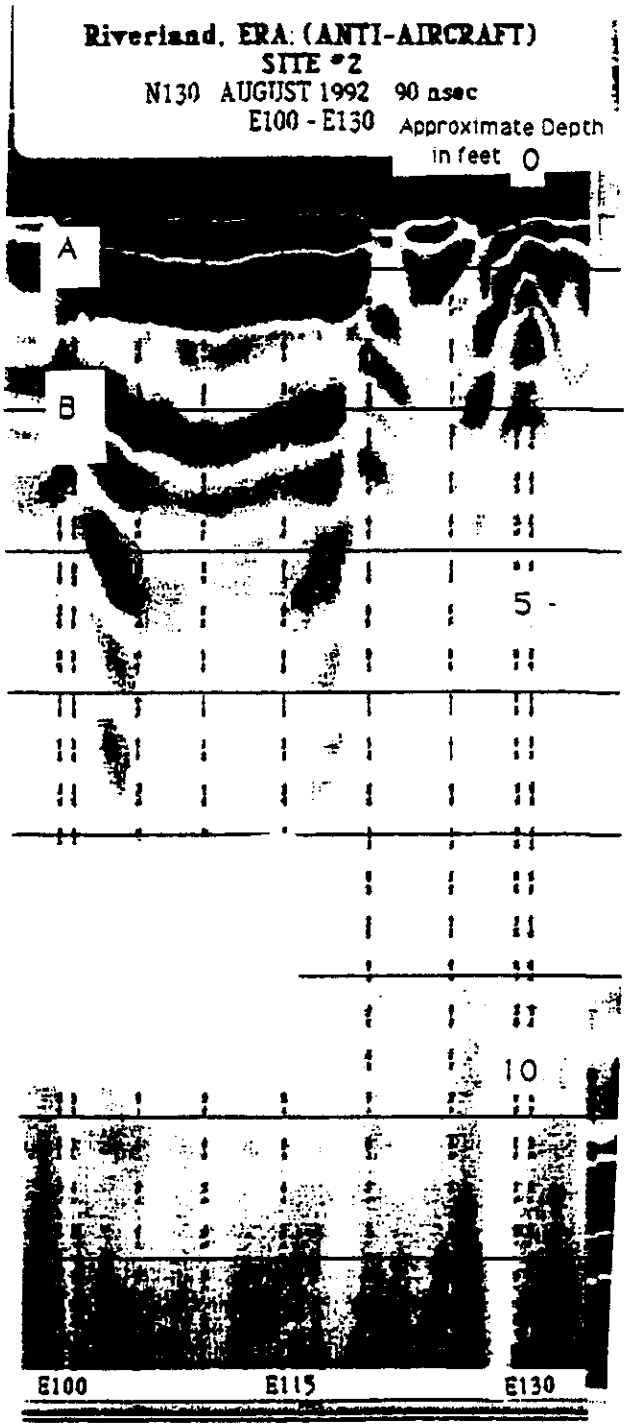


Figure 16. GPR Profile, AAA Site #2.



A = Shallow "Slab-like" Reflector
B = Intermittent Reflector Generally Found
1 to 3 Ft Below "Slab-like" Reflector

Figure 17. GPR Interpretation Summary of Riverland ERA AAA Site #3.

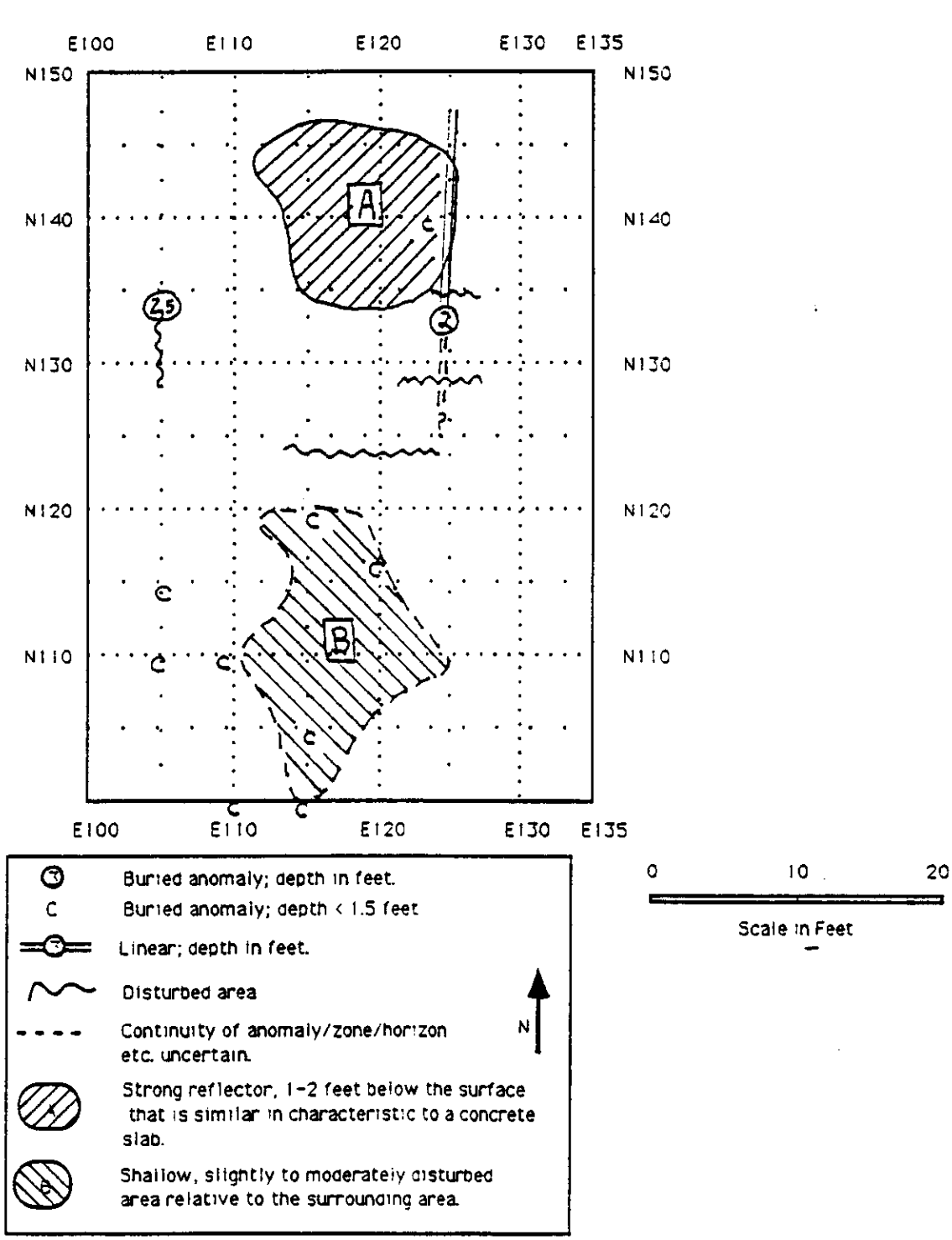
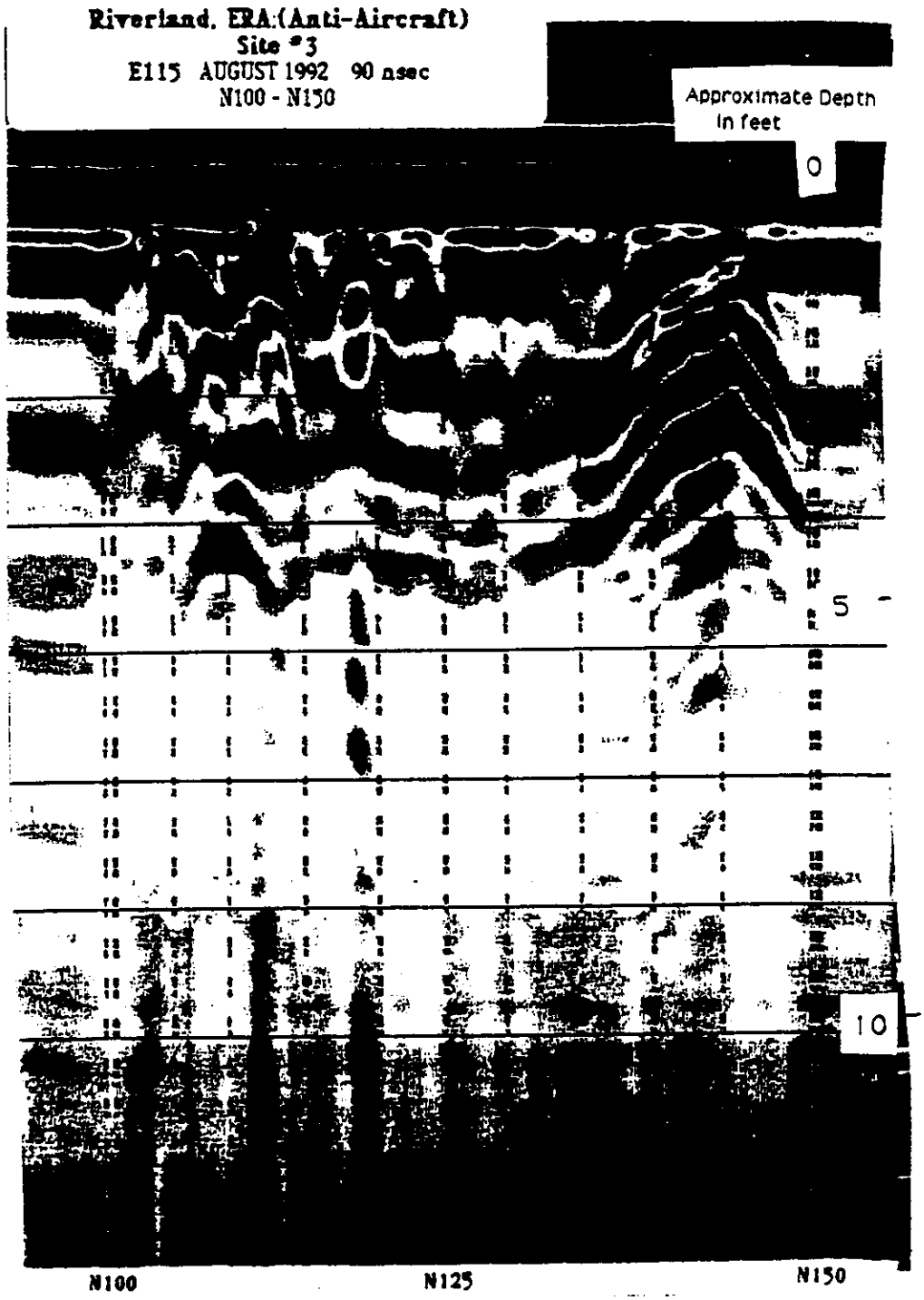


Figure 18. GPR Profile, AAA Site #3.



A = Disturbed Zone Containing "Buried Debris"
1 to 3 Ft Below the Surface
B = "Slab-like" Reflector 1 to 2 Ft Below
the Surface

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